# FABOX DOC

Songhui Cao

June 22, 2020

## 1 Laser Cut

The purpose of this assignment is to use laser cutter. The result, after assembling, is shown below.

Figure 1: Figure for Proj1

There are basically two parts. They can be found in proj1/proj1-part1of2.dxf and proj1/proj1-part2of2.dxf. Note that in these files, the diameter of the laser is set to 0.20 mm. If you want to change the kerf, please refer to proj1/proj1-main.f3d. In this file, there are several parameters. The table below is the summary of all parameters.

| Name | Description |
|---|---|
| _csh_comp0_depth | Depth of the junction |
| _csh_comp0_inner_R | As the name |
| _csh_comp0_outer_R | As the name |
| _csh_comp0_thickness | **Thickness** of the material minus kerf |
| _csh_comp0_inner_width | As the name |
| _csh_comp1_delta | As the name |
| _csh_delta | **Kerf.** |

You may modify the parameters, but do not modify them too much so as to avoid errors or warnings raised by Fusion.

## 2 3D Print

A simple item. I created this item because I am poor at creativity. It is made by extruding two shapes and cut off their common part. The item looks like this:

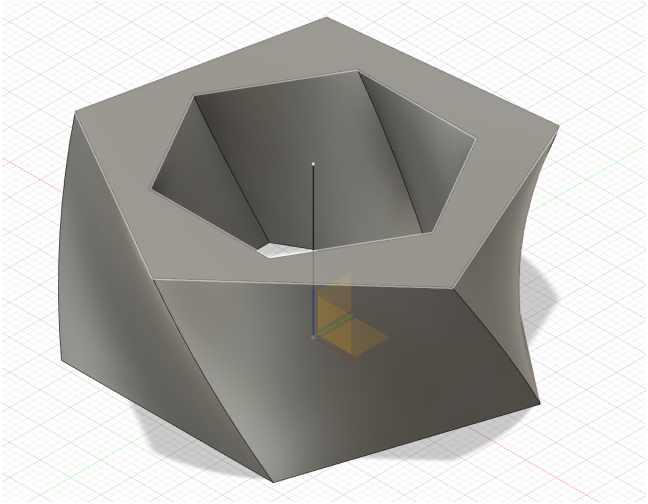

Figure 2: Figure for Proj2

Pango is the preferred slicing tool. Thickness or other parameters may be defined by yourselves. The STL file can be found at proj2/proj2-main.stl. The Fusion 360 project file is proj2/proj2-main.f3d.

## 3 Making Machines

In this section, we made drawing machines in small groups. Assembling this machine is not so difficult, but we learnt how to work in parallel on one single machine. The driver and detailed documentation can be found in out teacher's github repo https://github.com/faboshanghai/sh-tech-fabox-2020/blob/master/Mchine Design/Software/README.md .

Driving this machine is difficult because it uses two step motors with relatively high voltage ( 20 Volts) , so drivers like A4988 is required. One more thing, while we can use A4988 without CNC shield, in this project we still uses CNC shield. For more information, please follow the instructions in the repo.

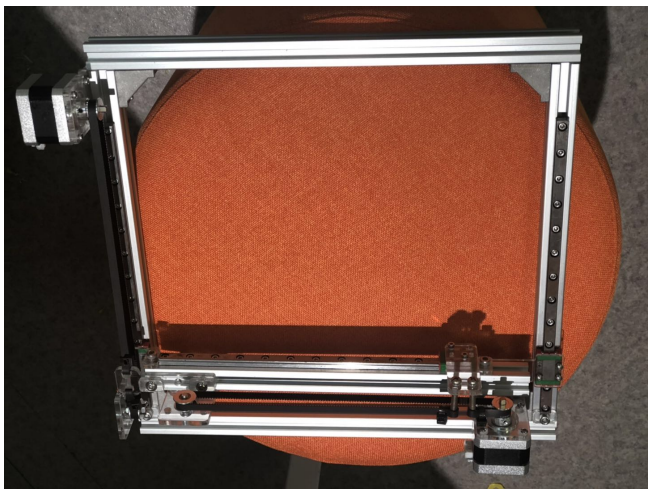

Figure 3: Figure for Proj3

# 4 3D Scanning

In this section, we uses a 3D scanner to scan ourselves. The scan result of myself can be found in Wechat group.

We also uses a much advanced 3D scanner to scan a Zongzi. The scan result is about 900 MiB large, so it cannot be uploaded to GitHub. The document of the 3D scanner can be found on the manufacturer's website. The URL is http://www.einscan.cn/.

# 5 Final Project

Basically this project is inspired by Immersive Engineering, a mod of Minecraft.

Figure 4: Figure for Final

All of the machine, except for the axis of the motor, is made by laser cut. For some unknown reasons, the diameter of the laser becomes 0.25 mm, which means that 0.20 mm is not enough. Files and their usage is listed below:

| Name | Copies required | Description |
|---|---|---|
| final/Center.Side.dxf | 8 | The side face of the 8-polygon in the center. |
| final/Center.Top.dxf | 2 | The top/bottom face of the 8-polygon in the center. |
| final/DecorationCase.dxf | 8 | Decorational case of the project. |
| final/Encapsulation.dxf | 1 | A big box used to contain the wiring. |
| final/Side.Decoration1.dxf | 0 | For decoration purpose only. Optional. |
| final/Side.Support.dxf | 8 | For connection purpose. |
| final/testAxis.stl | 8 | Used to extend the length of the axis from the motor. |

The hole in final/Center.Side.dxf and final/DecorationCase.dxf should be connected by final/Side.Support.dxf. The hole in final/Center.Top.dxf and the axis of the motor should be filled by final/testAxis.stl. Due to some unknoen reasons, the diameter of the hole in final/Center.Side.dxf is different from each other , so sometimes need glue to harden the connection. Also, makercase.com gives wrong design in final/Center.Top.dxf, therefore glue is definitely required to assemble the 8-polygon.

For wiring, an A4988 is preferred to simplify the connection. If we use 28BYJ-48 step motor, the connection of A4988 could be

| Name | Connection |
|---|---|
| DIRECTION | Connect to controller. |
| STEP | Connect to controller. |
| SLEEP | Connect to RESET. |
| RESET | Connect to SLEEP. |
| MS1 | Unused. |
| MS2 | Unused. |
| MS3 | Unused. |
| ENABLE | Connect to controller. Usually apply LOW voltage. |
| GND(Top) | Connect to GND of +5V. |
| VDD | Connect to +5V. |
| 1B | Connect to orange cable of the motor. |
| 1A | Connect to pink cable of the motor. |
| 2A | Connect to yellow cable of the motor. |
| 2B | Connect to blue cable of the motor. |
| GND(Bottom) | Connect to GND of $[+8, +12]$ V. |
| VMOT | Connect to $[+8, +12]$ V. |

Note that we need to open the motor and cut the red wire to make it a open circuit. Also, 9V is preferred.

The controller is final/proj4-ctrl.ino. By default, the definition is listed as below

| Name | Connection |
|---|---|
| 4 | Connect to DIRECTION. |
| 5 | Connect to STEP. |
| 6 | Connect to ENABLE. |
| A0 | Connect to sensor. |

The macros defined in final/proj4-ctrl.ino can be modified and they are self-commented.

The function of this code is: by default the motor rotates in one direction, but if the sensor value exceeds `_SH_DELTA_PER_CIRCLE` from the initial value, the motor rotates in another direction. Originally I wanted to change the speed, but then I found that the accuracy is not enough, so I decides to change the direction: this is more visible than speed.